

IN THE CLAIMS:

- 1 1. (Currently amended) A method for megasonic cleaning a substrate, comprising the
2 steps of:
- 3 a) providing a container having side walls on all sides of said container, said
4 container having an overflow;
- 5 b) providing at least one from the group including a first megasonic transducer
6 with a first active surface or and a first array of megasonic transducers with
7 a first array active surface for providing vibrational energy in said container;
- 8 c) disposing a substrate in said container within said sidewalls, below said
9 overflow, and substantially parallel to and spaced a first spacing from at
10 least one from the group including said first active surface or from and said
11 first array active surface;
- 12 d) flowing a fluid through said first spacing;
- 13 e) immersing the substrate in said fluid in said container, wherein said fluid
14 flows over said overflow; and
- 15 f) applying energy to at least one from the group including said first
16 megasonic transducer or to and said first array of megasonic transducers to
17 provide vibration in said fluid and to clean the substrate wherein
18 substantially all vibration provided in said fluid is from at least one from the
19 group including said first megasonic transducer, from said first array of
20 megasonic transducers, a transducer or from transducers arranged parallel to
21 said first active surface, and a transducer arranged or parallel to said first
22 array active surface.

- 1 2. (previously presented) A method as recited in claim 1, further comprising the step of
2 providing relative motion between said substrate and said transducer in a direction
3 substantially parallel to the substrate, while performing said fluid-flowing and
4 energy-applying steps (d) and (f).
- 1 3. (currently amended) A method as recited in claim 1, wherein said substrate has a
2 substrate surface area and at least one from the group including said first active
3 surface or and said first array active surface has an area at least equal to 40% of the
4 substrate surface area.
- 1 4. (previously presented) A method as recited in claim 1, wherein the substrate has a
2 maximum diameter and said first spacing is in a range from 1% to 80% of said
3 maximum diameter.
- 1 5. (previously presented) A method as recited in claim 1, wherein said first spacing is in
2 a range from 1 micrometer to 160 millimeters.
- 1 6. (Currently Amended) A method as recited in claim 1, wherein said megasonic energy
2 applied to at least one from the group including said first megasonic transducer or
3 and said first array of megasonic transducers has a frequency of at least 400
4 kilohertz.
- 1 7. (Currently Amended) A method as recited in claim 1, wherein said megasonic energy
2 applied to at least one from the group including said first megasonic transducer or
3 and said first array of megasonic transducers has a maximum power of at least 400
4 watts.

- 1 8. (Currently Amended) A method as recited in claim 7, wherein said megasonic energy
2 is applied to at least one from the group including said first megasonic transducer or
3 and said first array of megasonic transducers with 20% to 100% of said maximum
4 power.
- 1 9. (previously presented) A method as recited in claim 1, wherein said first megasonic
2 transducer has an area and a total input power and wherein said input power divided
3 by said area is at least four watts per square centimeter.
- 1 10. (previously presented) A method as recited in claim 1, wherein said flowing a fluid
2 step (d) comprises flowing a fluid through said first spacing at a fluid flow rate
3 sufficient to carry particles away from the substrate before they redeposit on the
4 substrate.
- 1 11. (previously presented) A method as recited in claim 1, wherein said container has a
2 volume and wherein said flowing a fluid step (d) comprises flowing a fluid through
3 said first spacing at a rate to replace the fluid in said volume in less than or equal to
4 one minute.
- 1 12. (Withdrawn) A method as recited in claim 1, further comprising the step of providing
2 at least one from the group including a second megasonic transducer with a second
3 active surface or and a second array of megasonic transducers with a second array
4 active surface in said tank, wherein at least one from the group including said second
5 active surface or and said second array active surface faces at least one from the
6 group including said first active surface or and said first array active surface, and is
7 substantially parallel to and spaced a second spacing from at least one from the group
8 including said first active surface or and said first array active surface.

1 13. (Withdrawn) A method as recited in claim 12, wherein in said providing step (b) at
2 least one from the group including said first megasonic transducer or and said first
3 array of megasonic transducers and at least one from the group including said second
4 megasonic transducer or and said second array of megasonic transducers are both
5 completely immersed in said fluid.

1 14. (Withdrawn) A method as recited in claim 12, wherein said disposing step (c)
2 comprises disposing the substrate in the tank between at least one from the group
3 including said first active surface or and said first array active surface and at least one
4 from the group including said second active surface or and said second array active
5 surface.

1 15. (Withdrawn) A method as recited in claim 14, wherein said flowing step (d) further
2 comprises flowing the fluid through said second spacing.

1 16. (Withdrawn) A method as recited in claim 15, wherein said applying energy step (f)
2 further comprises applying energy to said second megasonic transducer.

1 17. (Withdrawn) A method as recited in claim 12, wherein said transducers first
2 megasonic transducer and said second megasonic transducer provide energy to clean
3 both sides and edges of the substrate.

1 18. (Withdrawn) A method as recited in claim 1, wherein said fluid comprises one of
2 deionized water, dilute RCA cleaning solution and dilute citric acid solution.

1 19. (Canceled)

1 20. (Canceled)

- 1 21. (previously presented) A method as recited in claim 1, wherein in said flowing step
2 (d) fluid is provided in said tank at a lower level than it exits said tank
- 1 22. (previously presented) A method as recited in claim 1, wherein in said providing step
2 (b) said first transducer is completely immersed in said fluid.
- 1 23. (currently amended) A method for megasonic cleaning a single substrate, comprising
2 the steps of:
- 3 a) providing a container comprising at least one from the group including a first
4 megasonic transducer with a first active surface arranged in a horizontal plane
5 and a first array of megasonic transducers with a first array active surface
6 arranged in a horizontal plane, wherein at least one from the group including
7 said first megasonic transducer and said first array of megasonic transducers is
8 held in a fixed position, and wherein said container has side walls on all sides,
9 said container having an overflow;
- 10 b) disposing a single substrate in said container within said sidewalls, below said
11 overflow, and substantially parallel to and spaced a spacing from said first active
12 surface or said first array active surface;
- 13 c) immersing the single substrate in a fluid and flowing said a fluid through said
14 spacing, wherein said fluid flows over said overflow; and
- 15 d) applying energy to said first megasonic transducer wherein substantially all
16 vibration provided in said fluid is from at least one from the group including
17 said first megasonic transducer, from said first array of megasonic transducers,
18 or from transducers a transducer arranged parallel to said first active surface or
19 and a transducer arranged parallel to said first array active surface.

24-58. (Canceled)

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1 59. (Currently Amended) A method for megasonic cleaning a single substrate,
2 comprising the steps of:

3 (a) providing a container having side walls on all sides of said
4 container, said container having an overflow;

5 (b) providing a first megasonic transducer with at least one from the
6 group including a first active surface or and a first array of
7 megasonic transducers with a first array active surface, wherein at
8 least one from the group including said first active surface or
9 and said first array active surface is arranged in a horizontal plane
10 to provide megasonic vibration in said container;

11 (c) disposing a single substrate in said container within said sidewalls,
12 below said overflow, facing, substantially parallel to, and spaced a
13 first spacing from at least one from the group including said first
14 active surface or and said first array active surface, wherein said
15 single substrate is within said sidewalls and below said top edge;

16 (d) providing a fluid in said container, immersing said single substrate
17 in said fluid, and flowing said fluid through said spacing, wherein
18 said fluid flows over said overflow; and

19 (e) applying energy to said first megasonic transducer, wherein
20 substantially all vibration provided in said fluid is from at least
21 one from the group including said first megasonic transducer, from
22 said first array of megasonic transducers, ~~or from transducers a~~
23 transducer arranged parallel to said first active surface or and a
24 transducer arranged parallel to said first array active surface.

1 60. (previously presented) A method as recited in claim 59, wherein said single substrate
2 has a substrate surface area and said first active surface or said first array active
3 surface has an area at least equal to 40% of the substrate surface area.

1 61. (previously presented) A method as recited in claim 59, wherein said single substrate
2 has a substrate surface and said first megasonic transducer or said first array of
3 megasonic transducers is larger than said substrate surface.

1 62. (previously presented) A method as recited in claim 59, wherein the single substrate
2 has a maximum diameter and said first spacing is in a range from 1% to 80% of said
3 maximum diameter.

1 63. (previously presented) A method as recited in claim 59, wherein said first spacing is
2 in a range from 1 micrometer to 160 millimeters.

1 64. (previously presented) A method as recited in claim 59, wherein said megasonic
2 energy applied to said first megasonic transducer or said first array of megasonic
3 transducers has a frequency of at least 400 kilohertz.

1 65. (previously presented) A method as recited in claim 59, wherein said megasonic
2 energy applied to said first megasonic transducer or said first array of megasonic
3 transducers has a maximum power of at least 400 watts.

1 66. (Currently Amended) A method as recited in claim 65, wherein said megasonic
2 energy is applied to at least one from the group including said first megasonic
3 transducer or and said first array of megasonic transducers with 20% to 100% of said
4 maximum power.

- 1 67. (previously presented) A method as recited in claim 59, wherein said first megasonic
2 transducer has an area and a total input power and wherein said input power divided
3 by said transducer area is at least four watts per square centimeter.
- 1 68. (previously presented) A method as recited in claim 59, wherein said flowing a fluid
2 step (d) comprises flowing a fluid through said space between the single substrate
3 and said transducer first spacing at a fluid flow rate sufficient to carry particles away
4 from the single substrate before they redeposit on the single substrate.
- 1 69. (previously presented) A method as recited in claim 59, wherein said container has a
2 volume and wherein said flowing a fluid step (d) comprises flowing a fluid through
3 said space between the single substrate and said transducer first spacing at a rate to
4 replace the fluid in said volume in less than or equal to one minute.
- 1 70. (Currently Amended) A method as recited in claim 59, further comprising the step of
2 providing at least one from the group including a second megasonic transducer with
3 a second active surface or and a second array of megasonic transducers with a second
4 array active surface in said tank, wherein at least one from the group including said
5 second active surface or and said second array active surface faces at least one from
6 the group including said first active surface or and said first array active surface, and
7 is substantially parallel to and spaced a second spacing from at least one from the
8 group including said first active surface or and said first array active surface.
- 1 71. (Currently Amended) A method as recited in claim 70, wherein in said providing step
2 (b) at least one from the group including said first megasonic transducer or and said
3 first array of megasonic transducers and at least one from the group including said
4 second megasonic transducer or and said second array of megasonic transducers are
5 both completely immersed in said fluid.

- 1 72. (Currently Amended) A method as recited in claim 70, wherein said disposing step
2 (c) comprises disposing the single substrate in the tank between at least one from the
3 group including said first active surface or and said first array active surface and at
4 least one from the group including said second active surface or and said second
5 array active surface.
- 1 73. (previously presented) A method as recited in claim 72, wherein said flowing step (d)
2 further comprises flowing the fluid through said second spacing.
- 1 74. (previously presented) A method as recited in claim 73, wherein said applying energy
2 step (f) further comprises applying energy to said second megasonic transducer.
- 1 75. (previously presented) A method as recited in claim 70, wherein said first megasonic
2 transducer and said second megasonic transducer provide energy to clean both sides
3 and edges of the single substrate.
- 1 76. (previously presented) A method as recited in claim 59, wherein said fluid comprises
2 one of deionized water, dilute RCA cleaning solution and dilute citric acid solution.
- 1 77. (Currently Amended) A method as recited in claim 1, wherein at least one from the
2 group including said first megasonic transducer or and said first array of megasonic
3 transducers is larger than said substrate.
- 1 78. (previously presented) A method as recited in claim 23, wherein said first megasonic
2 transducer is larger than said single substrate.
- 1 79. Cancel

- 1 80. (Currently Amended) The method as recited in claim 1, wherein in said providing
2 step (b) at least one from the group including said first active surface or and said first
3 array active surface is arranged in a horizontal plane.
- 1 81. (Withdrawn) The method as recited in claim 1, wherein in said providing step (b) at
2 least one from the group including said first active surface or and said first array
3 active surface is arranged in a vertical plane.

- 1 82. (New) A method for megasonic cleaning a substrate, comprising the steps of:
- 2 a. providing a first megasonic transducer with a first active surface;
- 3 b. providing a second megasonic transducer with a second active surface facing
- 4 said first active surface and substantially parallel thereto;
- 5 c. disposing a substrate between said first surface and said second surface to
- 6 provide a first space between the substrate and said first surface and a second
- 7 space between the substrate and said second surface;
- 8 d. flowing a fluid through said first space and through said second space; and
- 9 e. applying energy to said first megasonic transducer and to said second megasonic
- 10 transducer to provide vibration in said fluid and to clean the substrate wherein
- 11 substantially all vibration provided in said fluid is from a transducer arranged
- 12 parallel to said first active surface.
- 1 83. (New) A method as recited in claim 82, further comprising the step of providing
- 2 relative motion between said individual substrate and said transducer in a direction
- 3 substantially parallel to the substrate, while performing said fluid-flowing and
- 4 energy-applying steps (d) and (e).
- 1 84. (New) A method as recited in claim 82, wherein the substrate has a maximum
- 2 diameter and said space is in a range from 1% to 80% of said maximum diameter.
- 1 85. (New) A method as recited in claim 82, wherein said space is in a range from 1
- 2 micrometer to 160 millimeters.

- 1 86. (New) A method as recited in claim 82, wherein said megasonic energy applied to
2 said megasonic transducer has a frequency of at least 400 kilohertz.
- 1 87. (New) A method as recited in claim 82, wherein said megasonic energy applied to
2 said megasonic transducer has a maximum power of at least 400 watts.
- 1 88. (New) A method as recited in claim 82, wherein said megasonic energy is applied to
2 said megasonic transducer with 20% to 100% of said maximum power.
- 1 89. (New) A method as recited in claim 82, wherein said transducer has an area and a
2 total input power and wherein said input power divided by said transducer area is at
3 least four watts per square centimeter.
- 1 90. (New) A method as recited in claim 82, wherein said flowing a fluid step (d)
2 comprises flowing a fluid through said first space and through said second space at a
3 fluid flow rate sufficient to carry particles away from the substrate before they
4 redeposit on the substrate.
- 1 91. (New) A method as recited in claim 82, wherein said container has a volume and
2 wherein said flowing a fluid step (d) comprises flowing a fluid through said spaces
3 at a rate to replace the fluid in said volume in less than or equal to one minute.
- 1 92. (New) A method as recited in claim 82, wherein in said providing step (b) said first
2 transducer and said second transducer are both completely immersed in said fluid.
- 1 93. (New) A method as recited in claim 82, wherein in said disposing step (c) said
2 substrate is completely immersed in said fluid.

1 94. (New) A method as recited in claim 82, wherein said megasonic transducers provide
2 energy to clean edges of the substrate.

1 95. (New) The method as recited in claim 24, wherein said fluid comprises one of
2 deionized water, dilute RCA cleaning solution and dilute citric acid solution.

1 96. (New) A method as recited in claim 82, wherein in said providing step (b) said active
2 surface is arranged in a horizontal plane.

1 97. (New and withdrawn) The method as recited in claim 24, wherein in said providing
2 step (b) said active surface is arranged in a vertical plane.

1 98. (New) A method as recited in claim 82, wherein in said flowing step (d) fluid is
2 provided in said tank at a lower level than it exits said tank